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Disclaimer and Scope of Applicability

The Engineering Standards set forth herein are prepared for and are applicable ***only*** in those water service areas served by Denver Water.

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Materials Specification – 1

for

Ductile Iron Pipe

**Push-On Single Gasket Joint 3 Inch, 4 Inch, 6 Inch,
8 Inch, 12 Inch, 16 Inch, 20 Inch, 24 Inch, 30 Inch,
36 Inch, And 42 Inch Diameter**

1. General:

All ductile iron pipe shall be manufactured in accordance with AWWA C151, with the following additional requirements or exceptions.

2. Size of Pipe:

This Specification shall cover ductile iron pipe in 3 inch, 4 inch, 6 inch, 8 inch, 12 inch, 16 inch, and 20 inch, 24 inch, 30 inch, 36 inch, and 42 inch nominal diameters.

3. Joint Type:

Push-on Single Gasket type conforming with applicable requirements of AWWA C111. Joint types other than Push-on Single Gasket are acceptable if specifically approved by Denver Water.

4. Pipe Wall Thickness:

Pipe furnished under this Specification shall have the following minimum ductile iron wall thickness:

Nominal Pipe Diameter (Inches)	Minimum Ductile Iron Wall Thickness (Inches)
3	0.25
4	0.26
6	0.25
8	0.27
12	0.31
16	0.34
20	0.36
24	0.41
30	0.43
36	0.48

5. Pipe Length:

Pipe furnished under this Specification shall have normal laying lengths of either 18 feet or 20 feet. Random lengths are not acceptable.

6. Material Strength:

The grade of iron shall be 60/42/10.

7. Cement-Mortar Lining:

Pipe furnished under this Specification shall have standard thickness cement-mortar linings in accordance with AWWA C104.

8. Certification:

The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made, and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water.

9. Acceptable Manufacturers:

American Cast Iron Pipe

Griffin Pipe

Pacific States

U.S. Pipe

Materials Specification – 2 for Polyvinyl Chloride (PVC) Pressure Pipe

Elastomeric Gasket Joint 4 Inch, 6 Inch, 8 Inch, And 12 Inch Diameter

1. General:

All PVC pipe shall be manufactured in accordance with AWWA C900, or AWWA C909, with the following additional requirements or exceptions.

2. Size of Pipe:

This Specification shall cover polyvinyl chloride (PVC) pipe in 4 inch, 6 inch, 8 inch, and 12 inch nominal diameters with cast iron pipe equivalent outside diameters.

3. Joint Type:

Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint.

Solvent cement joints are strictly prohibited.

4. Class and Type:

Sizes 6 inch, 8 inch and 12 inch shall be Class 150 Dimension Ratio 18 (DR 18). Four inch shall be Class 200 Dimension Ratio 14 (DR 14).

5. Pipe Length:

Each length of pipe will be a standard laying length of 20 feet. Random lengths are not acceptable.

6. Certification:

The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made, and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water.

7. Acceptable Manufacturers:

Certain-Teed Corporation
J-M Manufacturing Company
Extrusion Technologies, Inc.
Ipex, Inc.
Diamond Plastic Corporation
Ultra Blue (Molecularly Oriented PVC)

Materials Specification – 3 for Ductile Iron And Cast Iron Waterworks Fittings

1. General:

All cast iron and ductile iron fittings shall be manufactured in accordance with the following: AWWA C104, C110, C111, and C153 with the following additional requirements or exceptions.

2. Linings:

All sizes of cast iron sleeves shall be furnished without a cement-mortar lining. All other fittings shall be furnished with a cement-mortar lining of standard thickness and given a seal coat of asphaltic material or other material specified as defined in referenced standards. Unpainted fittings shall be subject to approval by Denver Water.

3. Type of Joint:

All fittings installed in the City and County of Denver or Total Service Areas shall be furnished with mechanical joint ends conforming to referenced standards, and in addition the tee-head bolts and hexagon nuts shall be fabricated from a high-strength, low alloy steel known in the industry as Cor-Ten or Usalloy or ductile iron Durabolt or equal.

Accessories for the mechanical joint consisting of the gasket, gland and fasteners shall be furnished and packaged separately from the fittings. Each package shall be labeled in such a manner as to provide for proper identification and the number of units per package or bundle.

4. Thickness Class:

Gray Iron fittings shall have a minimum of 250 psi pressure rating, ductile iron and ductile iron compact fittings shall be 350 psi pressure rating, and shall conform to the dimensions, weights and pressure rating shown in the tables of referenced standards.

5. Material:

All fittings shall be made from cast iron or ductile iron.

6. Certification:

The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water.

7. Acceptable Manufacturers:

Tyler Pipe Industries
U.S. Pipe

Griffin Pipe Products
Union Foundry Company
Star Pipe Products
Sigma

Material Specification – 4 for Double-Disc Gate Valves

1. General:

All valves supplied under this specification shall be designed and manufactured in accordance with AWWA C500, with the following additional requirements or exceptions.

2. Valve Description:

Valves shall be iron body, double disc gate valves, fully bronze mounted, with non-rising stem and parallel seats.

3. Installation:

Valves will be installed with the stem vertical in buried horizontal water lines without gearing, bypasses, rollers or tracks.

4. Service:

All valves shall be suitable for frequent operation as well as service involving long periods of inactivity. Valves shall be capable of operating satisfactorily with flows in either direction. The operating pressure for all sizes shall be 200 psig.

5. Valve Stems:

Valves shall be furnished with 2 inch square wrench nuts. The wrench nut shall comply with AWWA C500. Stem seal shall consist of O-rings in accordance with AWWA C500. The valves shall open by turning to the right.

6. Bolting Material:

Bonnet and gland bolts and nuts shall be either fabricated from a low alloy-steel for corrosion resistance or electro plated with zinc or cadmium. The hot dip process in accordance with ASTM A 153 is not acceptable.

7. End Connections:

A. Flanges:

Flanges shall be sized and drilled in accordance with ANSI B16.1 Class 125. Flanges shall be machined to a flat surface with serrated finish in accordance with AWWA C207.

B. Mechanical Joint:

All components of this type of joint shall conform to AWWA C111. The tee-head bolts and hexagon nuts shall be fabricated from a high-strength, low alloy steel known in the industry as Cor-Ten, Usalloy, or shall be ductile iron Durabolt.

Accessories for the mechanical joint consisting of the gasket, gland and fasteners shall be furnished and packaged separately from the valves. Each package shall be labeled in such a manner as to provide for proper identification and the number of units per package or bundle.

8. Testing:

Each valve, after shop assembly, shall be given the operation and hydrostatic tests in accordance with AWWA C500.

9. Coating:

All valves shall be painted or coated in accordance with AWWA C500. Machined flange faces shall not be painted or coated with the same coating as the body, but shall be shop coated with a rust preventive compound.

10. Certification:

The manufacturer shall furnish a sworn statement that the inspection and all the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water.

11. Acceptable Manufacturers:

Mueller
Clow

Materials Specification – 4A for Resilient Seated Gate Valves

150 Pound Class – 3 Inch Through 12 Inch Nominal Diameter

1. General:

All valves supplied under this Specification shall be designed and manufactured in accordance with AWWA C509, with the following additional requirements or exceptions.

Reduced-wall gate valves may be supplied in accordance with AWWA C515.

2. Valve Description:

Valves shall be iron body, resilient seated gate valves with non-rising stems. If the resilient seats are bonded to the gates, the gates shall be totally encapsulated with the material, with the exception of any guide tabs or slots. Valve bodies shall be designed to allow lifting of the valves by the bonnet flange, gland flanges or other appurtenances.

3. Installation:

Valves will be installed with the stem vertical in buried horizontal water lines without gearing, bypasses, rollers or tracks.

4. Service:

All valves shall be suitable for frequent operation as well as service involving long periods of inactivity. Valves shall be capable of operating satisfactorily with flows in either direction, and shall provide zero leakage past the seat. The operating pressure for all sizes shall be 200 psig.

5. Valve Stems:

Valves shall be supplied with stems having a minimum yield strength of 40,000 psi and a minimum elongation in 2 inches of 12% and shall be made of bronze per ASTM B 763, Copper Alloy No. C99500 or stainless steel per ASTM A 276, Type 304 or 316; or AISI 420. Valves shall be supplied with wrench nuts in accordance with AWWA C509. Stem seal shall consist of two (2) O-rings in accordance with AWWA C509. The valves shall open by turning to the right.

6. Bolting Material:

Bonnet and gland bolts and nuts shall be either fabricated from a low alloy-steel for corrosion resistance or electro-plated with zinc or cadmium. The hot-dip process in accordance with ASTM A 153 is not acceptable.

7. End Connections:

A. Flanges:

Flanges shall be sized and drilled in accordance with ANSI B16.1 Class 125. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA C207.

B. Mechanical Joint:

All components of this type of joint shall conform to AWWA C111. The tee-head bolts and hexagon nuts shall be fabricated from a high-strength, low alloy steel known in the industry as Cor-Ten, Usalloy, or shall be ductile iron Durabolt.

Accessories for the mechanical joint, consisting of the gasket, gland and fasteners shall be furnished and packaged separately from the valves. Each package shall be labeled in such a manner as to provide for proper identification and the number of units per package or bundle.

8. Testing:

Each valve, after shop assembly, shall be given the operation and hydrostatic tests in accordance with AWWA C509 or AWWA C515.

9. Coating:

All valves shall be painted or coated in accordance with AWWA C509 or AWWA C515. Machined flange faces shall not be painted or coated with the same coating as the body but shall be shop coated with a rust preventive compound.

10. Certification:

The manufacturer shall furnish a sworn statement that the inspection and all the specified tests have been made and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water.

11. Acceptable Manufacturers:

The following brands are the only ones to be considered as resilient seat gate valves under this Specification:

American Flow Control (C509 and C515)
Mueller (C509 only)
Clow (C509 only)
Kennedy (C509 only)
U.S. Pipe (C509 only)
American AVK (C509 only)
East Jordan Iron Works (C509 and C515)

Materials Specification – 5

for

Flanged Rubber Seated Butterfly Valves

1. General:

Except as modified or supplemented herein, all butterfly valves supplied under this Specification shall be designed and manufactured in strict compliance with AWWA C504. Unless specified otherwise, for valve sizes beyond the scope of AWWA C504, valve design shall be based upon the maximum service conditions with minimum safety factors of 3:1 on yield strength and 5:1 on ultimate strength. All Class 250 valves shall have ductile iron bodies with flange dimensions and drilling per ANSI B16.1, Class 125.

Valves supplied under this Specification may include three types: "buried", "in-plant", and "submerged". The type of valves, class of valves and type of actuators to be supplied should be specified.

2. Service:

All valves shall be suitable for throttling service and/or frequent operation as well as service involving long periods of inactivity. Valves shall be capable of operating satisfactorily with flows in either direction. Valves shall be suitable for use in potable and non-potable service.

3. Installation:

All valves specified as "buried" shall be for buried service in horizontal waterlines with the valve shaft horizontal and operating nut shaft vertical. Body of valves will be buried and the actuators will be installed in manholes.

All valves specified as "in-plant" shall be for service inside buildings or other structures in a relatively dry environment, protected from weather. The valves will be installed with valve shaft horizontal and the actuator directly coupled to the valve body.

All valves specified as "submerged" shall be for service inside basins or reservoirs. The valves will be installed with the valve shaft vertical, and will be mounted to a pipe flange. "Submerged" valves shall be supplied with torque tubes and actuator stands as shown on Sheet 84 of the Standard Drawings.

4. Shut Off Pressure:

The maximum static differential pressure across the valve will be the same as the class of the valve. At rated pressure, the valve shall be bubble tight for flows in either direction.

5. Class of Valve:

The class of valves shall be as specified.

6. Valve Bodies:

Valve bodies shall be of short body pattern. All Class 250 valve bodies shall be ductile iron. **Disc stops on the body will not be allowed.**

7. Valve Discs:

Valve disc shall seat at 90 degrees to the pipe axis. Discs having hollow chambers that can entrap water will not be allowed. All Class 250 valve discs shall be ductile iron.

8. Valve Seat:

Rubber seats may be applied to either the body or the disc. The mating seat surface, in either case, shall be stainless steel or sprayed in accordance with AWWA C504. Plated mating-seat surfaces will not be acceptable.

Rubber seats shall be of new natural or synthetic rubber and may be reinforced by the manufacturer.

Rubber seats mounted on the disc shall be a continuous full circle 360-degree seal, clamped thereon with corrosion resistant retaining rings, and threaded fasteners.

Rubber seats mounted in the groove of the valve body on valves 24 inch diameter and smaller may be bonded to the body. Bonded seats must withstand a 75-pound pull in accordance to the 90 degree stripping test procedure "Method B" of ASTM D 429.

Rubber seats mounted in the valve body on valves larger than 24 inch shall be full circle 360 degree and shall be retained in the valve body by mechanical means in such a manner that the seat can be adjusted to provide a tight shutoff. All hardware used in retaining the seat in the body shall conform to all the requirements of AWWA C504. Valve shaft shall not penetrate the rubber seat.

9. Valve Shaft:

The valve shaft shall be stainless steel and may be either through or stub type and shall conform to all applicable requirements of AWWA C504. Shafts for Class 250B valves shall be ASTM A 564, UNS Designation S17400, condition H1150.

10. Shaft Seal:

Where the valve shaft projects through the valve body for the actuator connection, a shaft seal designed for positive pressure within the valve shall be provided for the following sizes of valves:

A. For valves 24 inch diameter and smaller:

The seal shall be one of the following types:

- 1) Self-compensating V-type packing.
- 2) O-ring type contained in a corrosion resistant cartridge.

Retention of the above seals shall be designed to utilize the actuator case as a positioner of the seal. Replacement of seals shall be done without removal of the valve shaft.

B. For valves 30 inch diameter and larger:

- 1) Self-compensating V-type packing

2) Adjustable packing type

Retention of the above seals shall be designed to utilize a packing box with retainer or pull-down packing gland so that the packing can be field adjusted or completely replaced without disturbing any part of the valve or actuator assembly, except the retainer or packing gland follower.

On "buried" valves, the shaft seal area and exposed valve shaft shall be totally enclosed to prevent infiltration of material around the shaft seal and valve shaft during backfilling. Adjustable packing glands shall be accessible either through the bonnet as specified in Paragraph 14 or by removing the enclosure around the packing gland.

11. Valve Bearings:

Valve bearings shall conform to all applicable requirements of AWWA C504. In addition, valves furnished with an externally adjustable thrust bearing shall have the external adjusting mechanism enclosed in a substantial watertight housing.

12. Type of Valve Ends:

All valves shall be furnished with flanged ends. Dimensions and drilling shall conform to ANSI B16.1, Class 125. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA C207. The flanges shall have full-sized bolt holes through the flanges, except that drilled and tapped holes will be acceptable only in the areas where the shaft passes through the body. **Flanges with all holes tapped will not be allowed.**

13. Valve Actuators:

Unless otherwise specified, valves shall be furnished with manual worm gear actuators designed and sized to develop output torques for the specified operating service and shall be sufficient to seat, unseat and rigidly hold the disc in any intermediate position for the above conditions. The maximum velocity for actuator design shall be 16 feet per second.

A. "Buried" Valves

The actuators shall be Limitorque Type HBC, or EIM Type WD, designed to operate temporarily in a submerged condition in ten feet of water.

The actuators shall be equipped with 2 inch square operating nuts. The nuts shall be 1-15/16 inch square at the top, 2 inch square at the base, and 1-3/4 inch in height. The valves shall open with a clockwise rotation of the nut.

Stop-limiting devices shall be provided in the actuator for both open and closed positions. All actuator components between the input and the stops shall be designed to withstand, without damage, an input torque of 300 foot-pounds at the operating unit.

B. "In-Plant" and "Submerged" Valves

The actuators shall be Limitorque Type "T", Auma Model GS or EIM Type WO, provided with handwheels of suitable size to open the valves with the specified maximum pull.

The valves shall open with a clockwise rotation of the handwheel.

Stop-limiting devices shall be provided in the actuators for the open and closed positions. All actuator components between the input and these stops shall be designed to withstand, without damage, a pull of 200 pounds on the handwheel.

All gearing of the manual actuator shall be totally enclosed and sealed for a lubricant formulated for a temperature range of -10°F to $+150^{\circ}\text{F}$. Manufacturer shall fill the gear case with lubricant to 80% of full prior to shipment from the factory.

Primary gearing of actuator shall be a self-locking worm gear of high tensile bronze and a worm of hardened alloy steel with ground and polished threads.

Primary gearing shall be supplemented by spur gear attachment to comply with the following conditions of operation for all sizes of valves:

A. Minimum number of turns for complete opening or closing of valve disc shall not be less than 40 for all "buried" valves.

B. Maximum input torque required to fully open or close the valve for the specified service conditions shall not exceed 150 foot-pounds when applied to the operating nut, or an 80-pound pull when applied to the handwheel.

The diameter of the output shaft or spline of the actuator shall be sized equal to or greater than the turned-down section of the valve shaft.

All actuators shall have a valve position indicator.

14. Valve Bonnet:

"Buried" valves shall be furnished with a separate one piece cast iron or fabricated steel extension bonnet with (if applicable) access openings fitted with removable covers, located to permit access to the stuffing box for tightening the packing. The extension bonnet shall be 21 inches in length and shall be of a single diameter over its entire length. Minimum thickness of removable cover shall be 14 gauge (.0747") and shall be attached to extension sleeve with a minimum of four 1/4 inch diameter cap screws. Gasketing of the opening is not required.

15. Torque Tubes:

"Submerged" valves shall be supplied with torque tube type shaft extensions and actuator support stands as shown on Sheet 87 of the Standard Drawings. Each torque tube and actuator support stand shall be sized to operate under the maximum service conditions for the valve. The torque tube shall transmit the required torque to the valve without twisting or bending. The torque tube shall be connected to the valve shaft with a taper pin and nut or with a "keyed" fit.

16. Nameplates:

Corrosion-resistant nameplates shall be provided. There shall be one valve nameplate attached to the valve body, or for "buried" or "submerged" valves, attached to the valve actuator. The valve nameplates shall include the normal valve data and the serial number. There shall be one actuator nameplate attached to the valve actuator.

17. Manufacture:

All valves furnished shall be the latest standard products of a manufacturer regularly engaged in the production of equipment of this nature for a period of at least 5 years.

18. Testing:

The valve manufacturer shall test all valves according to AWWA C504.

19. Coatings:

A. Internal Surfaces:

All internal ferrous surfaces except machined or bearing surfaces shall be prepared for coating per SSPC-SP-10. These surfaces shall then be coated with a two-part thermosetting polyamide epoxy in two or more uniform coats, or with fusion bonded epoxy, to a minimum dry film thickness of 12 mils. Epoxy coating shall conform to AWWA C550 and shall be Ameron 400, Tnemec Series 140F Pota-Pox Plus, Corvel ECA-1626 or approved equal.

B. External Surfaces:

All external surfaces except machined or bearing surfaces shall be carefully prepared by removing all dirt, grease, and rust and shall be cleaned to the extent that the coating will bond to all surfaces.

For "buried" valves, the exterior of each valve except flange faces shall be shop coated with two coats of asphalt varnish, or shall be prepared and coated the same as the internal surfaces.

For "in-plant" valves, the exterior of each valve except flange faces shall be shop coated with one coat of polyamide anti-corrosive epoxy primer to a dry film thickness of not less than 3 mils.

For "submerged" valves, the external surfaces shall be prepared and coated the same as the internal surfaces.

Flange faces shall be shop coated with a rust preventive compound, Houghton "Rust-Veto 344", or Rust-Oleum "R-9".

After above painting is completed, a lubricant compatible with the rubber seal shall be applied to surface of this seal and the mating metal surface to prevent bonding of the two surfaces during shipment and storage. Following application of the seal lubricant, the valve disk shall be placed in a slightly open position for shipment.

20. Valve Assembly:

All "buried" and "in-plant" valves shall be shipped fully assembled. "Submerged" valves shall be assembled in the manufacturer's shop such that the torque tube is assembled to the valve shaft and the actuator adapter is mounted to the torque tube to ensure proper fit. The assembled valves shall be performance tested in accordance with AWWA C504. If the "submerged" valves are to be disassembled for shipment, the manufacturer shall match-mark all parts for assembly in the field by the OWNER. The torque tube connection to the valve shaft and the actuator shall also be "scribed" or otherwise marked to indicate relative orientation between the parts for field assembly.

21. Certification:

The manufacturer shall furnish a sworn statement that the inspection and all the specified tests have been made and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water.

22. Acceptable Manufacturers:

Mueller
Pratt
Rodney Hunt
SPX/K-Flo
Val-Matic
M&H Valve Company

Materials Specifications – 6 for Swing Check Valves

4 Inch Through 24 Inch Nominal Diameter

1. General:

All valves supplied under this Specification shall be designed and manufactured in accordance with AWWA C508, with the following additional requirements or exceptions.

2. Valve Description:

All valves shall be iron body and the disc shall be swing type.

3. Installation:

Valves shall be installed in a horizontal position. Some operating conditions may dictate the need for an assisted closure feature such as a counterweight or spring to reduce check valve slam.

4. Service:

All valves shall be suitable for frequent operation as well as service involving long periods of inactivity. The operating pressure for all sizes shall be 150 psig.

5. Bolting Material:

Bolts and hex nuts used for attaching top cap to the body shall be the manufacturer's standard, either fabricated from a low-alloy steel for corrosion resistance or electroplated with zinc or cadmium. The hot-dip process in accordance with ASTM A 153 is not acceptable.

6. End Connection:

All check valves shall be furnished with flanged ends. The size and drilling shall be in accordance with ANSI B16.1 Class 125. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA C207.

7. Testing:

Each valve after shop assembly shall be given the operation and hydrostatic tests in accordance with AWWA C508.

8. Coatings:

A. Internal Surfaces:

All internal ferrous surfaces except machined or bearing surfaces shall be prepared for coating per SSPC-SP-10. These surfaces shall then be coated with a two-part thermosetting polyamide epoxy in two or more uniform coats, or with fusion bonded epoxy, to a minimum dry film thickness of 12 mils. Epoxy coating shall conform to AWWA C550.

B. External Surfaces:

All external surfaces except machined or bearing surfaces shall be carefully prepared by removing all dirt, grease, and rust and shall be cleaned to the extent that the coating will bond to all surfaces.

The exterior of each valve except flange faces shall be shop coated with one coat of polyamide anti-corrosive epoxy primer to a dry film thickness of not less than 3 mils, or shall be prepared and coated the same as the internal surfaces.

Flange faces shall be shop coated with a rust preventive compound.

9. Certification:

The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water.

Materials Specifications – 6 for Swing Check Valves

4 Inch Through 24 Inch Nominal Diameter

1. General:

All valves supplied under this Specification shall be designed and manufactured in accordance with AWWA C508, with the following additional requirements or exceptions.

2. Valve Description:

All valves shall be iron body and the disc shall be swing type.

3. Installation:

Valves shall be installed in a horizontal position. Some operating conditions may dictate the need for an assisted closure feature such as a counterweight or spring to reduce check valve slam.

4. Service:

All valves shall be suitable for frequent operation as well as service involving long periods of inactivity. The operating pressure for all sizes shall be 150 psig.

5. Bolting Material:

Bolts and hex nuts used for attaching top cap to the body shall be the manufacturer's standard, either fabricated from a low-alloy steel for corrosion resistance or electroplated with zinc or cadmium. The hot-dip process in accordance with ASTM A 153 is not acceptable.

6. End Connection:

All check valves shall be furnished with flanged ends. The size and drilling shall be in accordance with ANSI B16.1 Class 125. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA C207.

7. Testing:

Each valve after shop assembly shall be given the operation and hydrostatic tests in accordance with AWWA C508.

8. Coatings:

A. Internal Surfaces:

All internal ferrous surfaces except machined or bearing surfaces shall be prepared for coating per SSPC-SP-10. These surfaces shall then be coated with a

two-part thermosetting polyamide epoxy in two or more uniform coats, or with fusion bonded epoxy, to a minimum dry film thickness of 12 mils. Epoxy coating shall conform to AWWA C550.

B.External Surfaces:

All external surfaces except machined or bearing surfaces shall be carefully prepared by removing all dirt, grease, and rust and shall be cleaned to the extent that the coating will bond to all surfaces.

The exterior of each valve except flange faces shall be shop coated with one coat of polyamide anti-corrosive epoxy primer to a dry film thickness of not less than 3 mils, or shall be prepared and coated the same as the internal surfaces.

Flange faces shall be shop coated with a rust preventive compound.

9. Certification:

The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water.

Materials Specification – 7 for Tapping Valves - Mechanical Joint Type

1. General:

All valves supplied under this Specification shall be designed and manufactured in accordance with AWWA C500 or AWWA C509 or AWWA C515, with the following additional requirements or exceptions.

2. Valve Description:

Valves shall be ductile iron body, resilient wedge gate valve, fully bronze-mounted, with parallel seats; or resilient seated gate valves. If the resilient seats are bonded to the gates, the gates shall be totally encapsulated with the material, with the exception of any guide tabs or slots. All valves shall have non-rising stems.

3. Installation:

Valves will be installed with the stem vertical in buried horizontal water lines without gearing, by-passes, rollers or tracks.

4. Service:

All valves shall be suitable for frequent operation as well as service involving long periods of inactivity. Valves shall be capable of operating satisfactorily with flows in either direction. The operating pressure for all sizes shall be 200 psig.

5. Valve Stem:

Resilient seated gated valves shall be supplied with stems having a minimum yield strength of 40,000 psi and a minimum elongation in 2 inches of 12% and shall be made of bronze per ASTM B 763, Copper Alloy No. C99500 or stainless steel per ASTM A 276, Type 304 or 316; or AISI 420.

Valves shall be furnished with 2 inch square wrench nuts. The wrench nut shall comply with AWWA C500 or AWWA C509. Stem seal shall consist of two (2) O-rings in accordance with AWWA C500 or AWWA C509. Valves shall open by turning to the right.

6. Bolting Material:

Bonnet and gland bolts and nuts shall be either fabricated from a low alloy-steel for corrosion resistance, or electro-plated with zinc or cadmium. The hot-dip process in accordance with ASTM A 153 is not acceptable.

7. End Connections:

A. Inlet End of Valve:

Inlet end of the valve shall be flanged. All dimensions and drilling of this flange

shall conform to ANSI B16.1, Class 125. Flange faces shall be machined to a flat surface with a serrated finish in accordance with AWWA C207.

B. Outlet End of Valve:

Outlet end of the valve shall have a standard mechanical joint end conforming to AWWA C111. The face of the mechanical joint shall have a sufficiently smooth and even surface to allow a tight O-ring seal with the tapping equipment. Accessories for the mechanical joint consisting of the gasket, gland and fasteners shall be furnished. The tee-head bolts and hexagon nuts shall be fabricated from a high-strength low alloy steel known in the industry as Cor-Ten, Usalloy, or shall be ductile iron Durabolt. Both ends of the valve shall be covered for shipment, and the mechanical joint accessories shall be packed inside the body of the valve.

8. Seat Ring Size:

Body of the valve and seat opening shall be sized large enough to accommodate the following sizes of shell cutters:

Tapping Valve Nominal Diameter	Shell Cutter Diameter
4"	3 7/8" $\pm 1/32$ "
6"	5 13/16" $\pm 1/32$ "
8"	7 7/8" $\pm 1/32$ "
10"	9 3/4" $\pm 1/32$ "
12"	11 7/8" $\pm 1/32$ "

9. Testing:

Each valve, after shop assembly, shall be given the operation and hydrostatic tests in accordance with AWWA C500 or AWWA C509 or AWWA C515.

10. Coating:

All valves shall be painted or coated in accordance with AWWA C500, AWWA C509, or AWWA C515. Machined flange faces shall not be painted or coated with the same coating as the body, but shall be evenly coated with a rust preventative compound.

11. Certification:

The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water.

12. Acceptable Manufacturers:

Resilient Seated

American AVK

Mueller

Clow

Kennedy

U.S. Pipe & Foundry

American Flow Control: Not Allowed

Materials Specification – 8 for Fabricated Steel Tapping Sleeves

For Use On 4 Inch Through 20 Inch Nominal Diameter Pipe

1. General Requirements:

The manufacturer of the tapping sleeves shall be experienced in their design and construction, shall be regularly engaged in their manufacture, and shall have produced tapping sleeves of the sizes specified herein which have given successful service for a period of at least 5 years.

2. Service:

The tapping sleeves will be installed on the following types of pipe: (1) Cast Iron, (2) Ductile Iron, (3) Asbestos-Cement and (4) Polyvinyl Chloride (PVC).

The operating pressure for all 4 types of water pipe is 150 psig.

3. Material:

All steel plate used in fabrication of the tapping sleeves shall conform to ASTM A 36 or A 285, Grade C.

4. Flanges:

Flanges shall be fabricated from steel plate, and all dimensions shall conform to AWWA C207, Class D. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA C207. In addition, the machined face shall also be recessed for tapping valves in accordance with MSS SP-60.

5. Gaskets:

Gaskets shall be compounded from new materials, and the shape of cross-section of gasket shall provide adequate seal for the design pressure. Gaskets shall be shop glued to the groove provided in the body section.

6. Fasteners:

Bolts and hex nuts shall be stainless steel, Usalloy, Dresserloy, Cor-Ten, ductile iron Durabolt or approved equal.

7. Testing Outlet:

A 3/4 inch NPT by welded coupling shall be attached to the outlet nozzle of each tapping sleeve assembly complete with a 3/4 inch square head pipe plug.

8. Painting:

All surfaces of the sleeve shall be clean, dry and free from grease and dirt before painting. All surfaces of tapping sleeve except face of flange, bolts and nuts, shall be given a shop coat of manufacturer's standard coating. Face of flanges shall be shop coated with a rust preventive compound. Bolts and nuts shall be shipped bare, without paint or protective coating.

9. Certification:

The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water.

10. Acceptable Manufacturers:

Fabricated Steel

Ford Model FTSS
International Style 228
Romac FTS 420
Smith-Blair Model 622
J.C.M. Model 412

Stainless Steel

J.C.M. - Model JCM 432
Power Seal - Model 3490
Cascade Style CST

Materials Specification – 9 for Pressure Regulating Valves

1. Service:

The function of this valve is to reduce an existing high pressure to a pre-adjusted lower downstream pressure for varying rates of flow without causing shock or water hammer on the system.

2. Valve Description:

The pressure regulating valve shall be a hydraulically operated, pilot controlled, diaphragm or piston activated globe or angle valve. The valve shall be fully stainless steel or bronze-trimmed. An indicator rod shall be furnished as an integral part of the valve to show the valve position. The valve shall be designed to provide an access opening in the valve body for removing the internal parts without removing the main valve body from the line.

3. Material:

Valve body, flanges and covers shall be cast iron conforming to ASTM A 126, Class B or ASTM A 48, Class 35; ductile iron conforming to ASTM A 536, grade 65-45-12; or 300 series stainless steel. Bronze castings or parts for internal trim shall conform to ASTM B 62.

4. Valve Ends:

All valves shall be furnished with flanged ends sized and drilled in accordance with ANSI B16.1, Class 125. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA C207.

5. Pilot Valve:

The pilot valve for controlling operation of the main valve shall be a single seated, diaphragm operated and spring loaded type. The pilot valve shall be attached to the main valve with piping and isolation valves so arranged for easy access in making adjustments and also for its removal from the main valve while the main valve is under pressure.

6. Needle Valve:

The needle valve shall be all bronze or stainless steel and included with the main valve to control the speed of piston travel.

7. Operating Pressure:

The operating pressure shall be 150 psig.

8. Testing:

The body of the pressure regulating valve shall be given a hydrostatic test to 150% of the operating pressure specified herein. A seat leakage test shall be made at the operating pressure.

9. Coatings:

A. Internal Surfaces:

All internal ferrous surfaces except machined or bearing surfaces shall be prepared for coating per SSPC-SP-10. These surfaces shall then be coated with a two-part thermosetting polyamide epoxy in two or more uniform coats, or with fusion bonded epoxy, to a minimum dry film thickness of 12 mils. Epoxy coating shall conform to AWWA C550.

B. External Surfaces:

All external surfaces except machined or bearing surfaces shall be carefully prepared by removing all dirt, grease, and rust and shall be cleaned to the extent that the coating will bond to all surfaces.

The exterior of each valve except flange faces shall be shop coated with one coat of polyamide anti-corrosive epoxy primer to a dry film thickness of not less than 3 mils, or shall be prepared and coated the same as the internal surfaces.

Flange faces shall be shop coated with a rust preventive compound.

10. Certification:

The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water.

11. Acceptable Manufacturers:

Clay-Val
Golden-Anderson
Ross
Singer
Ames
OCV

Materials Specification – 10

for

One Inch Through Four inch Combination Air- Release And -Vacuum Valves

1. Valve Description:

Combination Air Release and Vacuum Valves shall be of the single body, double orifice type. The large orifice shall allow air to escape during pipeline filling and to enter during drainage of the pipeline. The small orifice shall release small pockets of air after the pipeline is filled and under pressure. Except as modified or supplemented herein, all air valves supplied under this Specification shall be designed and manufactured in strict compliance with AWWA C512. The valves shall be installed in a vertical position in an underground vault.

2. Valve Construction:

A. Standard Iron Body:

The valve body and cover shall be cast iron per ASTM A 48, Class 35 or ASTM A 126, Grade B; or ductile iron per ASTM A 536, Grade 65-45-12. Each valve shall be supplied with stainless steel trim, which includes the float, float arm, guide bushings, plug, and all connecting hardware.

B. Cylindrical Body:

The valve body shall be Type 304 stainless steel, and the ends shall be epoxy coated steel or Type 304 stainless steel, secured with Type 304 stainless steel rods. The floats shall be solid cylindrical high density polyethylene. The baffle plate, nozzle seat retaining plate, small orifice nozzle and all connecting hardware shall be stainless steel.

Valve seats shall be natural or synthetic rubber equal to Buna-N or EPDM.

All 3 inch and 4 inch valves shall be furnished with flanged inlets conforming in dimension and drilling to ANSI B16.1, Class 125. Each flange face shall be machined to a flat surface with a serrated finish in accordance with AWWA C207. All one inch and two inch valves shall be furnished with NPT inlets. All valves shall be provided with 1/2 inch NPT pipe plugs in the top cover and in the bottom of the body.

The operating pressure shall be 150 psi.

3. Size of Orifices:

All valves shall be furnished with orifice sizes as tabulated:

Valve Size	Inlet	Outlet	Small Orifice
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			Standard Body	Cylindrical Body
1"	1"	1"	5/64"	.047"
2"	2"	2"	3/32"	.047"
3"	3"	3"	3/32"	.059"
4"	4"	4"	3/32"	.059"

4. Testing:

Each assembled valve shall be tested in accordance with AWWA C512. The manufacturer shall furnish one certified copy of the test reports to the Board.

5. Coatings:

All interior and exterior ferrous surfaces of the valve except machined or bearing surfaces, and corrosion resistant components shall be prepared for coating per SSPC-SP-10. These surfaces shall then be coated with a two-part thermosetting polyamide epoxy in two or more uniform coats, or with fusion bonded epoxy, to a minimum dry film thickness of 10 mils. Epoxy coating shall conform to AWWA C550 and shall be Ameron 400, Tnemec Series 140F Pota-Pox Plus, Corvel ECA-1626, or approved equal. Flange faces shall be shop coated with a rust preventative compound.

6. Certification:

The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be sent to Denver Water.

7. Acceptable Manufacturers:

Standard Body

APCO, Models 143C, 145C, 147C and 149C

Val-Matic, Series #200

GA Industries, Figure 945

Cylindrical Body

Vent-O-Mat, Series RBX

Materials Specification – 11 for 6 Inch Valve Boxes

1. General:

The manufacturer of valve box components shall be experienced in their design and construction, shall be regularly engaged in their manufacture and shall have produced valve boxes which have given successful service for a period of at least 5 years.

2. Materials:

Valve box parts shall be made of gray cast iron, ASTM A 48, Class 35.

Use of an aluminum alloy as a casting material is not acceptable.

3. Box Description:

Valve boxes shall be the three-piece adjustable screw type. The top section shall be 16 inches long.

4. Certification:

The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification shall be sent to Denver Water.

5. Acceptable Manufacturers:

Tyler screw-type 6 inch cast iron valve box assembly Series 6860 with No. 160 oval base.

Star Pipe Model No. VBD160DMWW

Western States Pipe Model No. VBDEN

Olympic Foundry Inc. Model No. 450VB

Castings Inc. CI. 160B Oval Base

East Jordan Iron Works Series 8560

Materials Specification – 12 for Dry-Barrel Fire Hydrants

1. General:

Except as modified or supplemented herein, all fire hydrants shall be designed and manufactured in strict compliance with AWWA C502 with the following additional requirements or exceptions. All references made in this Specification are to the above standard unless otherwise noted.

2. Service:

All fire hydrants supplied under these Specifications shall be designed for a working pressure of 150 psi and each factory assembled unit shall be hydrostatically tested in accordance with AWWA C502. Shop tests for the body and main valve will be conducted at a pressure of 300 psi.

3. Size of Hydrant:

All hydrants shall have a main valve opening size of at least five and one quarter (5-1/4) inches.

4. Type of Hydrant:

Hydrants shall be the three-way type with one pumper nozzle and 2 hose nozzles all located on the same horizontal plane, at least 18 inches above ground line.

5. Inlet Connection:

Hydrant base shall be provided with a mechanical joint inlet to accommodate 6 inch diameter ductile iron pipe complete with plain rubber gasket, gland, bolts and nuts all in accordance with AWWA C111.

The bolts and nuts shall be a high strength low alloy corrosion resistant steel Cor-Ten or equal with a minimum yield of 50,000 psi conforming to ASTM A 242. Incorporated into the base shall be two lugs for rodding of pipe.

All mechanical joint accessories shall be attached to hydrant for shipment.

6. Main Valve Assembly:

Main valve of the hydrant shall be the compression type which closes with the water pressure. Seat ring shall be bronze with a machined face and external threads for threading into a bronze drain ring, or a bronze bushed shoe to provide bronze to bronze seating for the main valve. The assembly shall be sealed with O-rings.

Main valve shall be replaceable type fabricated of a resilient material with a threaded bottom plate or nut with a seal to prevent leakage of the hydrant shaft. The upper valve plate material shall be either bronze or epoxy coated ductile iron.

The valve assembly shall include one or more drain valves which will work automatically with the main valve and drain the barrel when the main valve is in the closed position. All drain tubes shall be bronze lined and sized large enough for the barrel to drain within 12 minutes when the barrel is sized for a 5 foot trench depth.

All parts of the main valve assembly shall be so designed that removal of the assembly from the barrel is accomplished without excavation in accordance with AWWA C502.

7. Operating Shaft and Nut:

The operating nut shall be bronze or ductile iron and shall be pentagon shaped with a finished height of 1-1/8 inch. The dimensions from point-to-flat shall be between 1-1/4 inch and 1-3/8 inch from the top and to the bottom of the nut. Bushings in the bonnet shall be so constructed that it will prevent the operating nut from traveling during opening or closing operation. Also the bushing shall house a gasket or seal to prevent moisture or foreign material from entering the lubricant reservoir.

All hydrants shall be grease lubricated or shall be the dry-top design where an oil reservoir provides permanent lubrication of the operating nut threads.

A stop nut located in the hydrant bonnet on the operating shaft shall prevent over travel of the main valve when being opened.

The hydrant shall open by turning the operating nut to the **right** (in a clockwise direction) and shall have an arrow on top of the bonnet to designate the direction of opening.

8. Pumper Nozzle and Cap:

The pumper nozzle shall be 4-1/2 inches nominal diameter with 5-3/8 inch outer diameter threads having 6 threads per inch. Threads shall be right-hand. It shall be the supplier's responsibility to match the thread requirements for Denver Water's hydrants. A sample nozzle will be furnished upon request.

Nozzle cap shall be furnished with a synthetic rubber gasket installed in a retaining groove and the dimensions and shape of the nozzle cap nut shall be the same as the operating shaft nut as described above.

Nozzle caps shall be furnished with security chains with one end of each securely attached to the upper barrel section of the hydrant.

9. Hose Nozzles and Caps:

The two hose nozzles shall be 2-1/2 inch nominal diameter with 7-1/2 threads per inch (2.5 - 7.5 N.H.). Threads shall be right-hand and National Standard in accordance with NFPA No. 194. Each hose nozzle shall include a nozzle cap with nut and security chain the same as described above.

10. Nozzle Attachment:

Outlet nozzles shall be fastened into the barrel by mechanical means and secured by a stainless steel pin or screw, bronze wedge or a ductile iron retainer. Nozzles shall be sealed by the use of O-rings.

11. Coatings:

The upper exposed section of the hydrant above ground shall be thoroughly cleaned and

then painted with a prime coat of a rust inhibitive primer followed by a 10 mil thick shop coat of heavy duty alkyd enamel paint. The paint color shall be yellow similar to Federal Color No. 13538.

All exposed exterior surfaces below the ground line shall be coated with asphalt varnish or equal in accordance with AWWA C502.

The interior of the hydrants shall be coated with an epoxy coating in accordance with AWWA C502. The epoxy paint shall be NSF/ANSI 61 approved.

12. Certification:

Manufacturer shall furnish a sworn statement stating that all hydrants furnished comply with all applicable provisions of AWWA C502 as modified or supplemented herein. A copy of the Certification including interior epoxy paint compliance with NSF/ANSI 61 shall be sent to Denver Water.

13. Traffic Features:

All hydrants shall be equipped with traffic features that include a break away flange or lug system with a shaft coupling.

14. Acceptable Manufacturers:

Manufacturer	Model No.
Mueller Company*	Centurion Model A-473
American Flow Control/Waterous*	Pacer WB-67-250
United States Pipe and Foundry Company*	Metropolitan 250 M-94
Clow F-2545	
Kennedy K-81D	
Centurion 423	

*** These brand names are the only ones considered for purchase by Denver Water, or for installation in the City and County of Denver and Total Service Areas. Other hydrant brands with appropriate model and options may be utilized by Distributor Contract Areas following approval for such use by Denver Water.**

Materials Specification – 13 for Polyethylene Encasement Material

1. General:

All polyethylene encasement material shall be manufactured in accordance with AWWA C105, with the following additional requirements or exceptions.

2. Materials:

The raw material used to manufacture polyethylene film shall be Type I, Class A, Grade E-1, in accordance with ASTM D 1248.

3. Physicals:

The polyethylene film shall meet the following test requirements:

Tensile Strength	1200 psi minimum
Elongation	300% minimum
Dielectric Strength	800 V/mil thickness minimum
Thickness	8 mils minimum nominal with minus tolerance not exceeding 10% of nominal
Flow Rate	0.4 maximum

4. Certifications:

The manufacturer shall furnish a sworn statement that the inspection and all of the specified tests have been made, and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification shall be sent to Denver Water.

Material Specifications – 14

for

Magnetic Drive Displacement Type Water Meters

5/8 Inch Through One Inch

Frost Proof

1. General:

All magnetic drive displacement type water meters, 5/8 inch through one inch, furnished under this standard, shall be manufactured in strict accordance with the latest edition of AWWA C700, C707, and C702 with the following additional requirements. The meter may be of a nutating disc or oscillating piston type.

2. Main Cases:

Main cases shall comply with NSF/ANSI 61 requirements.

3. Registers/Register Boxes:

Registers shall comply with AWWA C707 and shall be electronic digital encoder or mechanical encoder registers, with a permanent "potted" wire connection for Itron Encoder-Receiver-Transmitter (ERT) unit. Meters intended for pit installation shall be factory wired and potted to a wiring harness attached to a water tight quick connect terminal approved by Itron. Meters intended for indoor installation shall be factory wired and potted to a length of wire for later connection to an Itron remote ERT. Wire lengths and type of wire will be clearly indicated on Denver Water's purchase order. Only meter brands and models with registers certified or approved by Itron, Inc., as compatible with its ERTs shall be acceptable. If the encoder registers require programming to properly operate with the Itron remote and pit ERTs, each register shall be delivered pre-programmed to provide electronic readings for 6 dials or 3 boards as appropriate for the brand of meter. Register must be compatible with Itron ERTs using standard Itron ROCLs. Registers that require the ERT to use WYSISYG — ROCLs are not acceptable.

Registers shall be straight reading, magnetic drive, U.S. gallons, permanently sealed and protected from the environment or tampering by a formed joint that can be unsealed only by destroying one or more of the components forming the joint. Registers shall comply with AWWA C700, Table 4. Number wheels or stationary zeros used for billing purposes (1,000 gallons and up) shall have black numbers against white background. All digits under 1,000 gallons (whether stationary or movable) shall be white numbers with black background. The register will be equipped with a test hand and test index circle or test hand and graduated test number wheel.

Register boxes shall be equipped with a register cap and shall completely cover the register lens. The register cap shall be capable of being moved to another register to preserve a match between the stamped meter numbers on the register and on the meter

main case. The register box shall attach to the outer case of the meter by use of an interior or exterior locking device.

4. Meter Numbers:

The Denver Water meter number shall be plainly chisel stamped on the meter main case and on brass register caps. This meter number shall be heat stamped in a contrasting color on plastic register caps. The Denver Water meter number shall also be attached to the meter in bar code form 39 using a separate tag. Dimple type stamping methods and paper or plastic number labels affixed to the register are not acceptable.

The Manufacturer's serial numbers shall run consecutively for each meter in the group ordered and shall be stamped on the top of the register cap.

5. Bottom Plates:

Breakable bottom plates shall be of cast iron or a copper alloy not containing less than 75% copper. Cast iron bottom plates shall be coated with baked enamel, to an extent adequate to protect the cast iron from corrosion and shall be provided with a plastic liner. The plastic liner shall not prevent the bottom plate from breaking as designed.

6. Piston/Disc Spindles, Thrust Rollers, and Thrust Rollers, and Thrust Roller Bearing Plates:

Piston/disc spindles, thrust rollers, and thrust roller bearing plates shall be of monel or stainless steel in accordance with AWWA C700 or suitable engineering plastic.

7. Chambers:

Chambers shall be made of copper alloy containing not less than 85% or suitable engineering plastic.

8. Measuring Chamber Diaphragms:

Measuring chamber diaphragms shall be of monel or stainless steel in accordance to AWWA C700 or suitable engineering plastic.

9. Drive Spindle:

Up shaft or drive spindle shall be stainless steel or suitable engineering plastic. Driving pawl and magnet shall be securely fastened to drive spindle in a manner preventing loss of pawl during normal operation of the water meter.

10. External Fasteners:

All external fasteners shall be stainless steel as described in AWWA C700.

11. Test Certifications:

All meters shall comply with American Water Works Association test requirements for new coldwater displacement type water meters. Each meter shall be furnished with a tag attached to the meter displaying the results of the certified accuracy tests performed by the manufacturer. This tag shall identify the meter by the manufacturer's meter number, the Denver Water meter number, and a bar code form 39 representation of the Denver Water meter number.

12. Acceptable Manufacturers:

AMCO Water Metering Systems, Inc.: C700 with Pulser Digital Register

Badger Meters, Inc.: Recordall Disc Series Meter with RTR Pulser Register

Hersey Meters/Mueller Group: 400 Series IIS with ER electronic register and Itron reed switch assembly

Neptune Technology Group: T-10 Meter with ProRead or AutoDetect absolute encoder register*

Sensus Metering Systems: SR or SRII Sealed Register Meter with ECR or ICE encoder register programmed to Denver Water's specific requirements

*** In special circumstances as approved by Denver Water Sales**

Administration and Customer Service Field Sections, a Double Check T-10 Meter with ProRead or AutoDetect absolute encoder register may be used in lieu of a standard meter and an RPZ backflow preventer. This meter is available in 5/8 inch size only.

Material Specifications – 15

for

Magnetic Drive Displacement Type Water Meters

1-1/2 inch And 2 inch

1. General:

All magnetic drive displacement type water meters, 1-1/2-inch and 2-inch, furnished under this standard, shall be manufactured in strict accordance with the latest edition of AWWA C700, C707 and C702 with the following additional requirements. The meter may be of a nutating disc or oscillating piston type. Meters shall be designed for easy removal of internal parts without disturbing the connections to the pipeline or removal of the meter. Stainless steel mounting bolts and flange gaskets shall be furnished with each meter.

2. Main Cases/Flanges:

Main cases shall comply with NSF/ANSI 61 requirements. Flanges shall be two hole, oval type and shall not have slotted holes. The flanges shall be an integral part of the main case and shall be of the same material. Flanges shall not be removable from the main case.

3. Registers/Register Boxes:

Registers shall comply with AWWA C707 and shall be electronic digital encoder or mechanical encoder registers, with a permanent "potted" wire connection for Itron Encoder-Receiver-Transmitter (ERT) unit. Meters intended for pit installation shall be factory wired and potted to a wiring harness attached to a water tight quick connect terminal approved by Itron. Meters intended for indoor installation shall be factory wired and potted to a length of wire for later connection to an Itron remote ERT. Only meter brands and models with registers certified or approved by Itron, Inc., as compatible with its ERTs shall be acceptable. If the encoder registers require programming to properly operate with the Itron remote and pit ERTs, each register shall be delivered pre-programmed to provide electronic readings for 6 dials or 3 boards as appropriate for the brand of meter. Register must be compatible with Itron ERTs using standard Itron ROCLs. Registers that requires the ERT to use WYSISYG-ROCLs are not acceptable. Registers shall be straight reading, magnetic drive, U.S. gallons, permanently sealed and protected from the environment and tampering by a formed joint that can be unsealed only by destroying one or more of the components forming the joint. Registers shall comply with AWWA C700, Table 4. Number wheels or stationary zeros used for billing purposes (1,000 gallons and up) shall have black numbers against white background. All digits under 1,000 gallons (whether stationary or movable) shall be white numbers with black background. The register shall be equipped with a test hand and test index circle or test hand and graduated test number wheel.

Register boxes shall be equipped with a register cap and shall completely cover the

register lens. The register cap shall be capable of being moved to another register to preserve a match between the stamped meter number on the register cap and on the meter main case. The register box shall attach to the outer case of the meter by use of an interior or exterior locking device.

4. Meter Numbers:

The Denver Water meter number shall be plainly chisel stamped on the meter main case and on brass register caps. This meter number shall be heat stamped in a contrasting color on plastic register caps. The Denver Water meter number shall be attached to the meter in a bar code form 39 using a separate tag. Dimple type stamping methods and paper or plastic number labels affixed to the register are not acceptable.

Manufacturer's serial numbers shall run consecutively for each meter in the group ordered and shall be stamped on the top of the register cap.

5. Piston/Disc Spindles, Thrust Rollers, and Thrust Roller Bearing Plates:

Piston/disc spindles, thrust rollers, and thrust roller bearing plates shall be of monel or stainless steel in accordance with AWWA C700 or suitable engineering plastic.

6. Chambers:

Chambers shall be made of copper alloy containing not less than 85% copper or suitable engineering plastic.

7. Measuring Chamber Diaphragms:

Measuring chamber diaphragms shall be of monel, stainless steel or suitable engineering plastic.

8. Drive Spindle:

Up shaft or drive spindle shall be stainless steel or suitable engineering plastic. Driving pawl and magnet shall be securely fastened to drive spindle in a manner preventing loss of pawl during normal operation of the water meter.

9. External Fasteners:

All external fasteners shall be stainless steel as described in AWWA C700.

10. Tests:

All meters shall comply with American Water Works Association test requirements for new coldwater displacement type water meters. Each meter shall be furnished with a tag attached to the meter displaying the results of the certified accuracy tests performed by the manufacturer. This tag shall identify the meter by the manufacturer's meter number, the Denver Water meter number, and a bar code representation in form 39 of the Denver Water meter number.

11. Acceptable Manufacturers:

AMCO Water Metering Systems, Inc.: C700 with Pulser Digital Register

Badger Meters, Inc.: Recordall Disc Series Meter with RTR Pulser Register

Hersey Meters/Mueller Group: 500 Series IIS with ER electronic register and Itron reed switch assembly

Neptune Technology Group: T-10 Meter with ProRead or AutoDetect absolute encoder

register

Sensus Metering Systems: SR or SRII Sealed Register Meter with ECR or ICE encoder
register programmed to Denver Water's specific requirements

Material Specifications – 16

for

Magnetic Drive Compound Type Water Meters

3–Inch Through 6 inch

1. General:

All magnetic drive compound type water meters 3 inch through 6 inch, furnished under this standard, shall be manufactured in strict accordance with the latest edition of AWWA C702, with the following additional requirements. The displacement section of the meter may be of a disc or oscillating piston type. Meters shall be designed for easy removal of internal parts without disturbing the connections to the pipeline or removal of the meter. A tapped boss shall be provided near the outlet of the meter to provide for field-testing without removal of the meter. Stainless steel mounting bolts and flange gaskets shall be furnished with each meter.

2. Main Cases/Flanges:

Main cases shall comply with NSF/ANSI 61 requirements. Flanges shall be four hole round type and shall not have slotted holes. The flanges shall be an integral part of the main case and shall be of the same material. Flanges shall not be removable from the main case.

3. Registers/Register Boxes:

Registers shall comply with AWWA C707 and shall be electronic digital encoder or mechanical encoder registers, with a permanent "potted" wire connection for Itron Encoder-Receiver-Transmitter (ERT) unit. Meters intended for pit installation shall be factory wired and potted to a wiring harness attached to a water tight quick connect terminal approved by Itron. Meters intended for indoor installation shall be factory wired and potted to a length of wire for later connection to an Itron remote ERT. Only meter brands and models with registers certified or approved by Itron, Inc., as compatible with its ERTs shall be acceptable. If the encoder registers require programming to properly operate with the Itron remote and pit ERTs, each register shall be delivered pre-programmed to provide electronic readings for 6 dials or 3 boards as appropriate for the brand of meter. Register must be compatible with Itron ERTs using standard Itron ROCLs. Registers that require the ERT to use WYSISYG-ROCLs are not acceptable.

Registers shall be straight reading, magnetic drive, U.S. gallons, and permanently sealed and protected from the environment and tampering by a formed joint that can be unsealed only by destroying one or more of the components forming the joint. Registers shall comply with AWWA C702, Table 5. Number wheels or stationary zeros used for billing purposes (1,000 gallons and up) shall have black numbers against white background. All digits under 1,000 gallons (whether stationary or movable) shall be white numbers with black background. The register shall be equipped with a test hand and test

index circle or test hand and graduated test number wheel.

Register boxes shall be equipped with a register cap and shall completely cover the register lens. The register cap shall be capable of being moved to another register to preserve a match between the stamped meter number on the register cap and on the meter main case. The register box shall attach to the case of the meter by use of interior or exterior locking devices

4. Meter Numbers:

Dimple type stamping methods and paper or plastic number labels affixed to the register are not acceptable. The Denver Water meter number shall be plainly chisel stamped on the meter main case and on brass register caps. This meter number shall be heat stamped in a contrasting color on plastic register caps. The Denver Water meter number shall also be attached to the meter in bar code form 39 using a separate tag.

Manufacturer's serial numbers shall run consecutively for each meter in the group ordered and shall be stamped on the top of the register cap.

5. Piston/Disc Spindles, Thrust Rollers, and Thrust Roller Bearing Plates:

Piston/disc spindles, thrust rollers, and thrust roller bearing plates shall be of monel or stainless steel in accordance with AWWA C702.

6. Chambers:

Chambers shall be made of copper alloy containing not less than 85% copper.

7. Measuring Chamber Diaphragms:

Measuring chamber diaphragms shall be of monel or stainless steel in accordance to AWWA C702.

8. Drive Spindle:

Up shaft or drive spindle shall be stainless steel or suitable engineering plastic. Driving pawl and magnet shall be securely fastened to drive spindle in a manner preventing loss of pawl during normal operation of the water meter.

9. External Fasteners:

All external fasteners shall be stainless steel as described in AWWA C702.

10. Torrent Section:

The torrent section shall be constructed in accordance with AWWA C702 and will be provided with stainless steel fasteners.

11. Tests:

All meters shall comply with American Water Works Association test requirements for new coldwater compound type water meters. Each meter shall be furnished with a tag attached to the meter identifying the results of the certified accuracy tests performed by manufacturer. This tag shall identify the meter by the manufacturer's meter number, the Denver Water meter number, and a bar code representation in form 39 of the Denver Water meter number.

12. Acceptable Manufacturers:

AMCO Water Metering Systems, Inc.: C3000 with Pulser Digital Registers
Badger Meters, Inc.: RCDL Compound Series Meter with RTR Pulser Register
Hersey Meters/Mueller Group: MCTII Series Compound Meter with ER electronic register and Itron reed switch assembly
Neptune Technology Group: Tru/FLO Compound Meter with ProRead or AutoDetect absolute encoder registers
Sensus Metering Systems: SRH Compound Meter with ECR or ICE encoder register programmed to Denver Water's specific requirements

Materials Specification – 17 for Magnetic Drive Turbine Type Water Meters 3 Inch Through 16 Inch

1.

General:

All magnetic drive turbine type water meters, 3-inch through 16-inch, furnished under this standard, shall be manufactured in strict accordance with the latest edition of AWWA C701, with the following additional requirements. Meters shall be designed for easy removal of internal parts and strainer without disturbing the connections to the pipeline or removal of the meter. Strainers shall be furnished with each meter. The internal parts of the strainer shall be stainless steel. The casing of the strainer shall be provided with a removable top plate with stainless steel fasteners. Stainless steel mounting bolts and flange gaskets shall be furnished with each meter.

2.

Main Cases/Flanges:

Main cases 3 inch through 10 inch shall comply with NSF/ANSI 61 requirements. 12 inch and larger meters may be cast iron with a corrosion-resistant coating approved by Denver Water. Flanges shall be round in accordance with AWWA C701 and shall not have slotted holes. The flanges shall be an integral part of the main case and shall be of the same material. Flanges shall not be removable from the main case.

3.

Registers/Register Boxes:

Registers shall comply with AWWA C707 and shall be electronic digital encoder or mechanical encoder registers, with a permanent "potted" wire connection for Itron Encoder-Receiver-Transmitter (ERT) unit. Meters intended for pit installation shall be factory wired and potted to a wiring harness attached to a water tight quick connect terminal approved by Itron. Meters intended for indoor installation shall be factory wired and potted to a length of wire for later connection to an Itron remote ERT. Only meter brands and models with registers certified or approved by Itron, Inc., as compatible with its ERTs shall be acceptable. If the encoder registers require programming to properly operate with the Itron remote and pit ERTs, each register shall be delivered pre-programmed to provide electronic readings for 6 dials or 3 boards as appropriate for the brand of meter. Register must be compatible with Itron ERTs using standard Itron ROCLs. Registers that require the ERT to use WYSISYG-ROCLs are not acceptable.

Registers shall be straight reading, magnetic drive, U.S. gallons, dry, and permanently sealed and protected from the environment by a formed joint that can be unsealed only by destroying one or more of the components forming the joint. Registers shall comply with AWWA C701, Table 4. Number wheels or stationary zeros used for billing purposes (1,000 gallons and up) shall have black numbers against white background. All digits under 1,000 gallons (whether stationary or movable) shall be white numbers with black background.

The register shall be equipped with a test hand and test index circle or test hand and graduated test number wheel.

Register boxes shall be equipped with a register cap and shall completely cover the register lens. The register cap shall be capable of being moved to another register to preserve a match between the stamped meter numbers on the register and on the meter main case. The register box shall attach to the outer case of the meter by use of an interior or exterior locking device.

4.

Meter Numbers:

Dimpled type stamping methods and paper or plastic number labels affixed are not acceptable. The Denver Water's meter number shall be plainly chisel stamped on the meter main case and on brass register caps. This meter number shall be heat stamped in a contrasting color on plastic register caps. Manufacturer's serial numbers shall run consecutively for each meter in the group ordered and shall be stamped on the top of the register cap.

5.

Measuring Cages or Chambers:

Measuring cages or chambers shall be made of a copper alloy in accordance with AWWA C701.

6.

Measuring Turbines:

>Measuring turbines shall be made of materials in accordance with AWWA C701.

7.

Turbine Spindles:

Turbine spindles shall be made of stainless steel or monel.

8.

External Fasteners:

All external fasteners shall be stainless steel as described in AWWA C701.

10.

Tests:

All meters shall comply with American Water Works Association test requirements for new coldwater turbine type water meters. Each meter shall be furnished with a tag attached to the meter displaying the results of the certified accuracy tests performed by the manufacturer. This tag shall identify the meter by the manufacturer's meter number, the Denver Water meter number, and a bar code form 39 representation of the Denver Water meter number.

11.

Acceptable Manufacturers:

AMCO Water Metering Systems, Inc.: T3000 Turbine Meter with Pulser Digital Register

Badger Meters, Inc.: Recordall Turbo Series Meter with RTR Pulser Register

Hersey Meters/Mueller Group: Horizon Turbine Meter with ER electronic register and Itron reed switch assembly

Neptune Technology Group: HP High Performance Turbine Meter with ProRead or AutoDetect absolute encoder register

Sensus Metering Systems: Series W Turbo Meter with ECR or ICE encoder register programmed to Denver Water's specific requirements

Material Specifications – 17A for Magnetic Drive Turbine Type Water Meters 1-1/2-Inch And 2-Inch

1.

General:

All magnetic drive turbine type water meters, 1-1/2-inch and 2-inch, furnished under this standard, shall be manufactured in strict accordance with the latest edition of AWWA C701, with the following additional requirements. Meters shall be designed for easy removal of internal parts and strainer without disturbing the connections to the pipeline or removal of the meter. Stainless steel mounting bolts and flange gaskets shall be furnished with each meter.

2.

Main Cases/Flanges:

Main cases shall comply with NSF/ASNI 61 requirements. The main case shall be designed to include an integral stainless steel strainer with a removable top plate. Flanges shall be two hole oval type. The flanges shall be an integral part of the main case and shall be of the same material. Flanges shall not be removable from the main case.

3.

Registers/Register Boxes:

Registers shall comply with AWWA C707 and shall be electronic digital encoder or mechanical encoder registers, with a permanent "potted" wire connection for Itron Encoder-Receiver-Transmitter (ERT) unit. Meters intended for pit installation shall be factory wired and potted to a wiring harness attached to a water tight quick connect terminal approved by Itron. Meters intended for indoor installation shall be factory wired and potted to a length of wire for later connection to an Itron remote ERT. Only meter brands and models with registers certified or approved by Itron, Inc., as compatible with its ERTs shall be acceptable. If the encoder registers require programming to properly operate with the Itron remote and pit ERTs, each register shall be delivered pre-programmed to provide electronic readings for 6 dials or 3 boards as appropriate for the brand of meter. Register must be compatible with Itron ERTs using standard Itron ROCLS. Registers that require the ERT to use WYSISYG-ROCLs are not acceptable.

Registers shall be straight reading, magnetic drive, U.S. gallons, dry, permanently sealed and protected from the environment or tampering by a formed joint that can be unsealed only by destroying one or more of the components forming the joint. Registers shall

comply with AWWA C701, Table 4. Number wheels or stationary zeros used for billing purposes (1,000 gallons and up) shall have black numbers against white background. All digits under 1,000 gallons (whether stationary or movable) shall be white numbers with black background. The register shall be equipped with a test hand and test index circle or test hand and graduated test number wheel.

Register boxes shall be equipped with a register cap and shall completely cover the register lens. The register cap shall be capable of being moved to another register to preserve a match between the stamped meter numbers on the register and on the meter main case. The register box shall attach to the outer case of the meter by use of an interior or exterior locking device.

4.

Meter Numbers:

Dimple type stamping methods and paper or plastic number labels affixed to the register are not acceptable. The Denver Water meter number shall be plainly chisel stamped on the meter main case and on brass register caps. This meter number shall be heat stamped in a contrasting color on plastic register caps. The Denver Water meter number shall also be attached to the meter in bar code form 39 using a separate tag.

The Manufacturer's serial numbers shall run consecutively for each meter in the group ordered and shall be stamped on the top of the register cap.

5.

Measuring Cages or Chambers:

Measuring cages or chambers shall be made of a copper alloy in accordance with AWWA C701.

6.

Measuring Turbines:

Measuring turbines shall be made of materials in accordance with AWWA C701.

7.

Turbine Spindles:

Turbine spindles shall be made of stainless steel or monel.

8.

External Fasteners:

All external fasteners shall be stainless steel.

9.

Tests:

All meters shall comply with American Water Works Association test requirements for new coldwater turbine type water meters. Each meter shall be furnished with a tag

attached to the meter displaying the results of the certified accuracy tests performed by the manufacturer. This tag shall identify the meter by the manufacturer's meter number, the Denver Water meter number, and a bar code form 39 representation of the Denver Water meter number.

10.

Acceptable Manufacturers:

Material Specifications – 17B

for

Magnetic Drive Fire Service Type Water Meters

3 Inch Through 10 Inch Turbine Type

1. General:

All magnetic drive turbine type fire service water meters, 3 inch through 10 inch, furnished under this standard, shall be manufactured in strict accordance with the latest edition of AWWA C703, with the following additional requirements. The mainline meter and strainer must be UL-listed or FM approved. Meters main casings, internal parts, and strainers shall be designed for easy removal without disturbing the connections to the pipeline. Strainers, stainless steel mounting bolts, and flange gaskets shall be furnished with each meter.

2. Mainline Meter:

The mainline meter shall be a turbine type meter and shall comply with Denver Water material specifications MS17, Magnetic Drive Turbine Type Water Meters, and shall be UL-listed or FM approved.

3. Bypass Meter:

The bypass meter may be of the turbine type or compound type and shall comply with Denver Water Material Specifications MS-17 and MS-16 respectively. Ball valves shall be installed directly upstream of the meter and downstream of the bypass meter check valve.

4. Strainers:

Strainers shall have a removable top with flanged connections to the pipeline and to the meter. Cast iron coated with corrosion-resistant material may be used with approval of Denver Water. The internal parts of the strainer and all fasteners shall be stainless steel.

5. Automatic Valve:

The automatic valve may be of a weighted type or spring loaded type assembly and shall comply with AWWA C703.

6. Bypass Check Valve:

In addition to the requirements of AWWA C703, the bypass check valve shall have a removable top with test plug of a size suitable for the testing of the bypass meter according to AWWA test flow requirements.

7. Tests:

All meters shall comply with American Water Works Association test requirements for new coldwater turbine type water meters. Each meter shall be furnished with a tag, attached to the meter, identifying the meter by manufacturer's serial number and the

Denver Water meter number, including a bar code representation of the Denver Water meter number, and displaying the certified results of the manufacturer's accuracy test of the meter.

8. Acceptable Manufacturers:

AMCO Water Metering Systems, Inc.: T3000 Turbine Meter with Pulser Digital Register

Badger Meters, Inc.: Recordall Turbo Series Meter with RTR Pulser Register

Hersey Meters/Mueller Group: Horizon Series Turbine Meter with ER electronic register and Itron reed switch assembly

Neptune Technology Group: HP High Performance Turbine Meter with ProRead or AutoDetect absolute encoder register

Sensus Metering Systems: Series W Turbo Meter with ECR or ICE encoder register programmed to Denver Water's specific requirements

Materials Specification – 18

for

Normal Weight And Precast Concrete

1. Concrete Mix Submittal:

A minimum of 10 days prior to starting concrete work, concrete mix designs shall be submitted in accordance with ACI 301 for Denver Water approval. No changes shall be made in the amounts or sources of the approved mix ingredients without written approval of Denver Water. Production inspection and field testing of the approved mix may be made by Denver Water.

2. Concrete Products:

A. Cementitious Materials:

1) Cement

All Cement used shall be Type II portland cement which shall conform to the requirements of ASTM C 150.

2) Fly Ash:

Fly ash may be used in the concrete mixes. The amount of fly ash shall be 15% by weight of the total cementitious materials. Fly ash additions to the mix will be on a cement substitution basis. The fly ash shall conform to ASTM C 618.

B. Aggregates:

1) Fine Aggregates

Fine aggregate shall consist of natural sand or a blend of natural sand and crushed sand provided the quantity of crushed sand is not more than 50% of the total sand by dry weight. All fine aggregate shall conform to the grading and quality requirements of ASTM C 33.

2) Coarse Aggregates

Coarse aggregate shall consist of gravel or crushed stone and shall conform to the grading and quality requirements of ASTM C 33 for Size No. 467, No. 57, or No. 67. Nominal maximum size of coarse aggregate shall comply with ACI 318.

If the aggregates used are known to be reactive with high alkali cement, as determined by ASTM C 295, or if the reactivity of the aggregate is not known, the use of low alkali cement is required to assure adequate protection from alkali-aggregate reaction.

C. Water:

The batch mixing water and mixer washout water shall conform to the requirements ASTM C 94.

D. Admixtures:

Calcium chloride shall not be used.

An air-entraining agent shall be used in all concrete. The agent used shall conform to ASTM C 260. It shall be added to the batch in accordance with ASTM C 94.

Chemical admixtures which do not contain calcium chloride and which conform to ASTM C 494 for concrete may be used. All chemical admixtures shall be compatible with the cement and all other admixtures in the batch.

All damages or difficulties occurring as a result of the use of any admixtures shall be the responsibility of the user. Denver Water will not provide any compensation for concrete because of such difficulties. Use of admixtures shall in no way relieve the responsibility for protection and curing of the concrete.

3. Concrete Proportions:

Concrete shall be made in two classes: Class A concrete and Class B.

Class A concrete shall have a minimum 28 day compressive strength of 4000 psi when molded and cured as in compliance with ASTM C 31 and shall be used for all structural and precast concrete.

Class B concrete shall have a minimum 28 day compressive strength of 2500 psi when molded and cured as in compliance with ASTM C 31 and may be used for concrete kickblocks exclusively.

All concrete shall be air entrained to a total air content of 5% plus 2% or minus 1% of the volume of the batch. The minimum slump shall be 2 inches and the maximum slump shall be 4 inches as when tested in accordance with ASTM C 143.

Fine aggregates shall be between 36% and 44% by volume of the total aggregates in the concrete.

4. Enforcement of Strength Requirements:

Should the strengths by the laboratory cured test specimens made and tested in accordance with the provisions of the Standards and evaluated by the methods recommended in ACI 318 fall below the specified values, Denver Water shall have the right to require changes in the proportions of the concrete mix to be used on the remainder of the work.

Denver Water may require a minimum of three concrete cores drilled in the manner described in ASTM C 42 and tested for compressive strength in the manner described in ASTM C 39 for each portion of the work where the laboratory cured concrete test cylinders indicate failure to meet the specified strength requirement within the specified time period.

If the results of this test do not satisfy the strength requirements of this Standard, Denver Water shall have the right to require strengthening or replacement of those portions of the structure which have failed to develop the required strength.

Materials Specification – 19 for Controlled Low Strength Backfill Material (CLSM)

1. CLSM Mix Submittal:

A minimum of 2 days prior to starting CLSM work, CLSM mix designs shall be submitted for Denver Water approval. No changes shall be made in the amounts or sources of the approved mix ingredients without written approval of Denver Water. Production inspection and field testing of the approved mix may be made by Denver Water.

2. CLSM Products:

A. Cementitious Materials:

1) Cement

All cement used shall be Type II portland cement which shall conform to the requirements of ASTM C 150.

2) Fly Ash

The fly ash shall conform to ASTM C 618. Fly ash may be either Class C or Class F.

B. Aggregates:

1) Fine Aggregates

All fine aggregate shall conform to the grading and quality requirements of ASTM C 33.

2) Coarse Aggregates

Coarse aggregate shall conform to the grading and quality requirements of ASTM C 33 for Size No. 467, No. 57, or No. 67.

C. Water:

The batch mixing water and mixer washout water shall conform to the requirements ASTM C 94.

D. Admixtures:

Chemical admixtures which do not contain calcium chloride and which conform to ASTM C 494 for concrete may be used in the CLSM mix. All chemical admixtures shall be compatible with the cement and all other admixtures in the batch.

3. CLSM Proportions:

CLSM shall have a minimum 28 day compressive strength of 100 psi and a maximum 28

day compressive strength of 200 psi when molded and cured as in compliance with ASTM D 4832.

All CLSM shall be air entrained to a total air content of approximately 5%. The minimum slump shall be 6 inches and the maximum slump shall be 8 inches as when tested in accordance with ASTM C 143.

Fine aggregates shall be between 50% and 60% by volume of the total aggregates in the CLSM mix.

Mater

For use in the Denver Water Service Area

ials Specification for Concrete Reinforcement

1. Material:

All deformed reinforcing bars shall conform to ASTM A 615, Grade 40 or 60, or ASTM A 617, Grade 40 or 60. All welded steel wire fabric shall conform to ASTM A 185 except that the weld shear strength requirement shall be extended to include a wire size differential up to and including six gages.

Materials Specification – 21 for Brass And Bronze Goods

1. General:

All of the following brass goods shall be manufactured in accordance with AWWA C800, and all of the following bronze goods shall be manufactured using copper alloy UNS No. C83600 commercially known as 85-5-5 in accordance with ASTM B 62, with the following additional requirements or exceptions.

Each manufacturer shall submit samples to Denver Water for testing. If the manufacturer is approved, the sample shall be kept by Denver Water and used as the standard by which future purchases shall be compared.

2. Corporation Stops:

Corporation stops shall be AWWA Standard taper to copper and shall be of the type listed below or equal, approved by Denver Water:

Mueller	#H-15000	(Sizes 3/4" - 2")
Ford	#F-600	(Sizes 3/4" - 2")
Hays	#5200	(Sizes 3/4" - 2")
A.Y. McDonald	#4701	(Sizes 3/4" - 2")
James Jones	#J-1500	(Sizes 3/4" - 2")
Farnan	#W-100	(Sizes 3/4" - 2")
Ford	#FB-600	(Sizes 1" - 2")
Cambridge Brass	#102	(Sizes 3/4" – 2")

3. Curb Stops:

Curb stops shall be copper to copper and shall be of the type listed below or equal, approved by Denver Water:

Ford Ball Type	#B-22	(Sizes 3/4" - 2")
Mueller	#H-15204	(Sizes 3/4" - 2")
A.Y. McDonald	#6100	(Sizes 3/4" - 2")
James Jones	#J-1902	(Sizes 3/4" - 1")
James Jones	#J-1901	(Sizes 1-1/2" - 2")
with coupling	#J-1531	
Hays	#4304 (Size 3/4")	
Cambridge Brass	#202	(Sizes 3/4" – 2")

4. Meter Yokes (Line Setters):

Meter yokes shall be copper to copper and shall be of the type listed below or equal, approved by Denver Water:

Ford	#V-80 Series	(Sizes 5/8" - 1")
Ford	#CH88-333-9375	(Size 3/4")
Mueller	#H-14064	(Sizes 3/4" - 1")
Mueller	#H-1412	(Sizes 3/4" - 1")
Mueller	#H-1414	(Size 3/4")
A.Y. McDonald	#37D Series	(Sizes 3/4" - 1")
Hays	#25542	(Size 3/4")
Hays	#25523	(Size 1")

5. Stop and Waste Valve:

Stop and waste valves shall be the type listed below or equal, and approved by Denver Water:

Mueller	#H-15214	(3/4" through 2")
Ford	#Z22-3335W	(3/4")
Ford	#Z22-444SW	(1")
Red & White	#200	(3/4")
Red & White	#201	(1")
Hammond	#667-20	(3/4")
Hammond	#668-20	(1")
Kitz	#47, 48	(3/4" – 1")
Cambridge Brass	#203	(Sizes 3/4" – 2")

6. Gate Valves:

All gate valves under 3 inches for use with copper pipe shall be all bronze, with non-rising stems and solid wedge disc. The valve should be rated at 125 psi WSP and 200 psi WOG. Gate valves shall be of the type listed below or equal, and approved by Denver Water:

Red & White	#206	(3/4")
Red & White	#207	(1")
Kitz	#27	(3/4")
Kitz	#28	(1")
Hammond	#668	(3/4")
Milwaukee	#105	(3/4")

7. Ball Valves:

All ball valves under 3 inches for use with copper pipe shall be all bronze, full port ball valve, 400 psi WOG. Ball valves shall be of the type listed below or equal, and approved

by Denver Water:

Apollo	#95-104	(3/4")
Ford	#B22, #B44	(3/4" - 1")
Red & White	#5049, #5063	(3/4" - 1")
Mueller 300 Ball		
Curb Valve	#B25154	(3/4" – 2") Flare Both Ends
AY McDonald Curb Stop	#6104	(3/4" – 2") Flare Both Ends
Ford Curb Stop	#BH-22-233	(3/4" – 2") Flare Both Ends

8. Compression Fittings:

Mueller	#H15404	
	#H15409	(3/4" – 1")
AY McDonald Curb Stop	#4758Q	(3/4" – 1")

Materials Specification – 22 for Miscellaneous Items

1. Meter Couplings:

Couplings shall be of the type listed below or equal, approved by Denver Water:

Ford Meter Box Company

Lead to Copper Lead Pak	#Q 32-13	(1/2" x 3/4")
	#Q 22-23	(5/8" x 3/4")
	#Q 22-33	(3/4" x 3/4")
	#Q 12-44	(1" x 1")
	#C 44-33	(3/4" x 3/4")
Iron to Copper Pack Joint	#C 84-66	(1-1/2" x 1-1/2")
	#C 84-77	(2" x 2")
Copper to Copper Pack Joint	#C 44-66	(1-1/2" x 1-1/2")
	#C 44-77	(2" x 2")
Iron to Iron Pack Joint	#C 85-66	(1-1/2" x 1-1/2")
	#C 85-77	(2" x 2")
Brass to Brass Pack Joint (iron to iron)	#C 55-66	(1-1/2" x 1-1/2")
	#C 55-77	(2" x 2")
Flared Adapter Coupling	#C 28-66	(1-1/2" x 1-1/2")
	#C 28-77	(2" x 2")
Flanged Coupling Adapter Loc-Pak	#CF 35-66	(1-1/2" x 1-1/2")
	#CF 35-77	(2" x 2")

A.Y. McDonald

Union, Lead Flange x Copper Flare	#4742	(3/4" - 1")
Mac-Pak Compression Fittings	#4753-22	(3/4" - 2")
T Compression Fittings	#4753T	(3/4" - 2")

2. Service Line Insulators:

Insulators for service lines shall be Ford Service Insulators or equal, approved by Denver Water.

Insulated bolted sleeve type couplings shall be either Rockwell (Smith-Blair) Style 438 cast insulating coupling or Dresser Style 39 or equal, approved by Denver Water.

3. Harness Rods:

Mild steel (MS) harness rods shall be ASTM A 36. Hex nuts shall be ASTM A 307, Grade A or B, hexagon heavy series.

High Strength (HS) harness rods shall be ASTM A 193, Grade B7. Nuts shall be ASTM A 194, Grade 2H.

4. Curb Stop Service Boxes:

Curb stop service boxes shall be cast iron and shall be of the type listed below or equal, approved by Denver Water:

A. Curb stop boxes for 3/4 inch and one inch curb stops shall be Tyler 6500 Series, 5 foot extension, Size 94E stop box Buffalo Type complete, 2-1/2 inch shaft or D&L supply numbers M-9081 and M-9082.

B. Curb stop boxes for 1-1/2 inch and 2 inch curb stops shall be Tyler 6870 Series, 5 foot extension, Size I45R stop box Buffalo Type complete, 4-1/4 inch shaft.

5. Tapping Saddles:

Double bronze strapped tapping saddles for use with ductile iron and asbestos-cement pipe shall be of the type listed below or equal, approved by Denver Water:

Ford	#202B	(4" - 16")
Superior	#Style 36	(4" - 16")
Mueller	#H-I6I00 Series	(4" - 12")
Rockwell	#323	(3" - 20")
James Jones	#J-979	(3" - 16")
APAC	#112	(2" - 12")
APAC	#113	(14" - 30")
Powerseal	Model #3407	(3/4" - 2")
A.Y. McDonald	#3825	(4" - 12")

Bronze saddles for PVC pipe shall provide full support around the circumference of the pipe and have a bearing area of sufficient width along the axis of the pipe so that the pipe will not be distorted when the saddle is tightened of the type listed below or equal, approved by Denver Water:

James Jones	#J-996	(4"-12")
Mueller	#H-13400 Series	
for C900	(4"-12")	
Ford	#S-90	(4"-12")
Clow	#3407, 3408	(4"-12")

A.Y. McDonald
Powerseal

#3800
Model #3401, 3403

(4"-12")
(3/4"-2")

Materials Specification – 23 for Meter Pit Domes And Covers

1. General:

Meter pit domes and covers shall be of double lid frost proof construction and shall fit a 20 inch ID concrete meter pit ring.

2. Materials and Construction:

The meter pit dome may be constructed of aluminum in accordance with ASTM A 132, or cast iron in accordance with ASTM A 48.

The cap type top lid shall be cast iron or polymer concrete. The cast iron lid shall have a recess approximately 7 inches diameter by 3/4 inch deep to hold an Itron Pit ERT. There shall be a center hole, 2 inches in diameter to accept the ERT, and three drainage holes within the recessed area. The polymer concrete lid shall have integral supports to hold an Itron Pit ERT below the surface of the lid, in accordance with Itron's installation instructions. All top lids shall be furnished with a worm-gear locking bolt with a large 5-sided brass nut.

The inner frost lid shall be molded of high-density polyethylene at least 1/8 inch thick. The frost lid shall be dish-shaped with a recess 2-1/2 to 3 inches deep with three to five 1/4 inch diameter drainage holes located around the edge of the recessed area. There shall be a 1/4 inch wide notch the full width of the top lip, and a lifting tab projecting 2 inches inward with a 9/16 inch or larger hole.

3. Acceptable Manufacturers:

Castings, Inc.	#M-70-AL
	#M-70-CI
Armorcast Products Co.	Polymer Concrete Pit Lid

Materials Specification – 24 for Electric Pump Motors

1. Applicable Industry Standards:

Each motor shall conform to the ANSI C50, and NEMA MG-1 including ratings, characteristics and tests, unless otherwise specified herein. The nameplate horsepower rating of each motor shall be one of the standard NEMA values.

2. Voltage and Current:

Motors shall utilize standard nominal three-phase voltages of 460 or 480 volts alternating current depending on the required horsepower and the characteristics of the power distribution system.

The initial inrush current at full-rated applied voltage and locked rotor shall not exceed 600% of the full-load rated KVA.

All motors shall be suitable for across-the-line full voltage starting.

3. Operating Temperature and Insulation Classification:

The maximum temperature rise of the motor (at an operating altitude of 5,900 feet above sea level) shall not exceed 77° C above an ambient temperature of 40° C, per the NEMA Standards method for altitude derating, when the motor is delivering full rated continuous horsepower at rated voltage, frequency and power factor. The motor shall have, as a minimum, a NEMA Class B insulation system rating. A NEMA Class F system may be employed, however, the actual operating temperatures shall not exceed the value given above.

4. Enclosure and Cooling:

All motors shall have NEMA standard open drip-proof enclosure with internal fan cooling.

5. Bearings:

Motors may be equipped with either sleeve or anti-friction type bearings depending upon the horsepower, rotational speed, and load coupling methods required for the specific installation. For motors rated at 100 horsepower or larger, the bearings shall be oil lubricated from an oil reservoir equipped with a sight level gauge, and they shall be suitable for use with high quality turbine oil, such as Mobil DTE-13 or an approved equivalent. If anti-friction bearings are used, they shall be of standard AFBMA size and grade with a minimum rated L-10 life of 100,000 hours.

6. Service Factor:

Motors shall retain a service factor of 1.15 at the above specified elevation, operating temperature, and full load.

7. Acceptable Manufacturers:

Motors shall be supplied by the following approved manufacturers:

Electric machinery

Reliance

General Electric

Marathon

Louis-Allis

U.S. Motors

For approval as a equal by the Electrical Engineer of Denver Water, a motor manufacturer must have a local engineering representative and local repair facilities.

Materials Specification – 25 for In-Line Strainers

1. General:

All flanged in-line basket strainers shall be fabricated from cast iron in accordance with ASTM A 48. The strainers shall be approved by the NFPA and/or Underwriters Laboratories and shall be used for turbine meters where required by 6.18.

2. Flanges:

The strainer flanges shall be fabricated in accordance with ASTM A 126. They shall be faced and drilled in accordance with ANSI B16.1, Class 125.

3. Cover Plates:

The strainers shall be provided with a removable bolted top cover plate for inspection and removal of basket and debris. A 3/4 inch drain valve and an 3/4 inch vent valve shall be provided on the bottom and the top, respectively.

4. Baskets:

Strainer baskets shall be fabricated from UNS S31600 or high impact plastic, and shall have a net open area of at least 4 times the nominal size of the pipe in which the strainer is installed. The basket shall be easily removed from the strainer for periodic inspection and maintenance.

5. Operating Pressure:

The strainers shall be noted for a minimum operating pressure of 150 psig. Maximum head loss shall be 4 psi at maximum rated flow capacity.

Material Specification – 26 for Concrete Vaults

1. General:

The materials used to construct the vault shall conform to MS-19 and MS-20. Manholes, reducing sections, ladder rungs and traffic lids shall be precast and shall conform to ASTM C 478. If Denver Water requires it, the vaults shall be cast with a removable lid section for future access. The vault as a whole, and the individual components, i.e., the lid, walls and base slab, shall be adequately designed to handle all applicable loads. The concrete vault design calculations shall be furnished to Denver Water.

2. Traffic Lids and Roofs:

All traffic lids and roofs shall be designed for H-20 loading in accordance with AASHTO Standards. The roof slab shall be a minimum of 8 inches thick.

The opening through the roof shall be 36 inches in diameter. Additional reinforcement shall be added around the opening at 45 degree angles to the edges. This shall extend a minimum of 2 feet beyond the opening or the ends of the reinforcing bars shall be standard 180 degree hooks.

If a removable lid is required, the lid shall be cast in sections. The sections shall be cast such that their individual weight does not exceed 7,500 pounds, assuming reinforced concrete weighs 150 pounds per cubic foot. Three inch diameter holes shall be provided in the sections for lifting. The holes shall be perpendicular to the face of the lid surface. The holes shall not displace any of the required reinforcement nor should it protrude from either face of the roof. The holes shall be placed in such a manner that when lifting cables are being used there is an equal weight distribution on all cables.

3. Walls:

All four walls on cast in place vaults shall be cast in one continuous placement. All corners shall have added reinforcement. The walls shall be doweled into the floor. Precast vault walls shall be connected together by a plate and bolt type arrangement. Precast walls shall be appropriately secured to the floor slab.

The minimum wall thickness is 5 inches with the reinforcement being at least one inch from the inner face of the vault.

4. Base Slab:

The base slab shall be cast in place or precast conforming to 6.33 and Sheets 42, 43 and 45 of the Standard Drawings.

The manufacturer may cast vaults in which the base slab is integral with the wall sections.

5. Acceptable Manufacturers:

Rinker Materials

Amcor Concrete Products

(including 7800 Tunnel Vault)

Materials Specification – 27

for

Mechanical Joint Restraint

1. General:

All mechanical joint restraints shall be incorporated in the design of a follower gland. The gland shall be manufactured of ductile iron conforming to ASTM A 536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to AWWA C111 and C153.

2. Description:

The restraint mechanism shall consist of numerous individually activated gripping surfaces to maximize restraint capability. The gripping surfaces shall be wedges designed to spread the bearing surfaces on the pipe. Twist-off nuts, sized same as tee-head bolts, shall be used to insure proper actuating of restraining devices. When the nut is sheared off, a standard hex nut shall remain.

3. Pressure:

The mechanical joint restraint device for ductile iron pipe shall have a working pressure of at least 250 psi with a minimum safety factor of 2.

The mechanical joint restraint device for PVC shall have a working pressure of at least 150 psi with a minimum safety factor of 2:1.

4. Acceptable Manufacturers:

For Ductile Iron Pipe:

Romal Rom Grip		(4" – 36")
EBAA Iron, Inc.	Megalug 1100 series	(4" - 36")
Uni-Flange	Series 1400	(4" – 36")
Star Grip	Series 3000	(4" – 36")
Sigma – One Lok		(4" – 12")

For PVC Pipe:

EBAA Iron, Inc.	Megalug 2000 PV series	(4" - 12")
Sigma One Lok		(4" - 12")
Star		

For Bell – Spigot Device

Ductile Iron Pipe

Mega Lug Series 1700

U.S. Pipe Field Lok Gasket

PVC Pipe

Mega Lug Series 1500

For DI Pipe (Hydrants and Valves)

Mueller Aquagrip Restraint Device

Materials Specification – 28 for Bolted Sleeve Type Couplings

1. General:

Pipe couplings shall be in accordance with AWWA C219 and shall be of a gasketed, sleeve type, with diameter to properly fit the pipe. Each coupling shall consist of one center sleeve, two end rings, two rubber-compounded wedge section gaskets and sufficient bolts to compress the gaskets.

The manufacturer of the coupling shall be experienced in their design and construction shall be regularly engaged in their manufacture and shall have produced couplings of the sizes specified herein which have given successful service for a period of at least 5 years.

2. Service:

Couplings will be installed on the following types of pipe: 1) Cast Iron, 2) Ductile Iron, 3) Asbestos-Cement, 4) Polyvinyl Chloride. The manufacturer shall state in writing that the coupling must be sufficient for the types of pipe being joined.

3. Material:

The couplings shall be manufactured from either cast iron or ductile iron and shall conform to applicable ASTM Designations. For cast iron ASTM A 48 or ASTM A 126, Class B. For ductile iron ASTM A 536, any malleable iron shall conform to ASTM A 47.

4. Gaskets:

The gaskets of the coupling shall be composed of a crude or synthetic rubber base compounded with other products to produce a material which will not deteriorate from age or heat or exposure to air under normal storage conditions. It shall also possess the quality of resilience and ability to resist cold flow of the material so that the joint will remain sealed and tight indefinitely when subjected to shock, vibration, pulsation and temperature or adjustments of the pipeline.

5. Bolts:

Bolts and heavy hex nuts shall be stainless steel, US alloy, Dresserloy, Cor Ten or an approved equal.

The manufacturer shall supply information as to the recommended torque to which the bolts shall be tightened.

6. Acceptable Manufacturers:

Smith-Blair	Model 411
Dresser	Model 138-38

Romac

Ford

Baker

Power Seal

Model 501

Style FC1

Series 228

Model 3506

Materials Specification – 29 for Supervisory Control And Data Acquisition (SCADA)

1. General:

Equipment not specified on this sheet must be approved by Denver Water.

2. Control Systems:

Bristol Babcock Distributed Process Controllers (3330 series) or Synergetics Data Acquisition Systems (4100 series). Another control system may be used only if pre-approved by the Process Control Section of Denver Water.

3. Pressure Transmitters:

Rosemount pressure transmitters model #2088G or Bristol Babcock pressure transmitters model #2508.

4. Control Enclosures:

Hoffman enclosures.

5. Flow Transmitters:

Rosemount differential pressure transmitters model #1151DP. Two transmitters are required for flow indications; a high range transmitter calibrated to 25% of the maximum design flow rate. Utilize an AGM Suppression Discriminator model #TA-4014-2 for range selection switching.

6. Intrusion Alarms:

Square-D, Class 9007 Type C. Limit switches for intrusion alarms shall be heavy duty precision turret head type. Limit switch assembly shall be enclosed in die cast zinc standard box oil-tight and water-tight with SPDT snap action, silver alloy type contacts. The turret head shall be standard pre-travel spring return with Viton shaft seals on lever arm, plunger and wobble stick boots shall be neoprene. Lever arm type shall be operated in both CW and CCW directions, this mode of operation if field convertible.

7. Water on Floor Alarms:

B/W controls, Model 7010-L-4-A-20 with Part No. 12-085000 Weight, Part No. 12-084900 Cord Grip, and Part No. 12-085200 Wall Mount Bracket, unless sump pumps are required and supplied with alarm limit switches.

8. Pressure Sight Gauges:

Ashcroft Type 1010. Pressure gauges shall be industry general service Grade 1A, 1.0% F. S. accuracy, 12 inch diameter face, epoxy painted aluminum case, AISI 316 stainless

steel drawing C bourdon tube and socket, 1/4 inch NPT bottom piping connection, calibrated 0 to maximum operational psig.

9. Terminal Blocks:

Phoenix Controls #UK 6, 3-HESI, #UK 4-TG, #UK 5-MTK-P/P or equal. Din rail mount terminal blocks with disconnect. (Knife, plug or lever fuse disconnects, preferred).

Materials Specification – 30 for Fire Hydrant Meters

1. General:

All fire hydrant meters shall be manufactured in strict accordance with AWWA C 701.

2. Material and Construction:

Meter housing shall be aluminum with straightening vanes, strainer, fire hose couplings and gate valve after meter or after required backflow device.

3. Registers:

Registers shall be straight read, permanently sealed, magnetic drive and 100 U.S. Gallon sweep.

4. Measuring Element:

Measuring element shall be easily removed for required maintenance.

5. Installations:

Fire hydrant meter installation requires a Denver Water approved backflow device. Meters and backflow device shall be completely supported.

Any fire hydrants that are used and damaged by a Contractor will be repaired by Denver Water at the expense of the Contractor.

6. Approved Meter Manufacturers:

AMCO Water Metering Systems, Inc.: H3200 Fire Hydrant Meter

Badger Meters, Inc.: Model FHM Fire Hydrant Meter

Hersey Meters/Mueller Group: Model HM Fire Hydrant Meter

Neptune Technology Group: Fire Hydrant Meter

Sensus Metering Systems: Model 125-W Fire Hydrant Meter

Badger Recordall II

Neptune

Sensus W-125.

7. Approved Backflow Device Manufacturers (RPZ):

Approved backflow device (RPZ) are to be used with fire hydrant meter and a gate valve to control flow. Current approved list can be obtained through our backflow prevention officer.

8. Backflow Prevention:

Any backflow prevention device required will be a model and size designated by Denver Water and approved by the Colorado Department of Public Health and Environment. The term approved backflow prevention assembly will mean a device that has been manufactured in full conformance with AWWA C511 and, have met completely the laboratory and field performance specifications of the Foundation for Cross Connection Control and Hydraulic Research (FCCC&HR) of the University of Southern California established by: Specifications of Backflow Prevention 69-2, or the most current issue. AWWA and FCCC&HR standards and specifications are adopted by Denver Water. Final approval of backflow prevention devices will be evidenced by a Certificate of Approval issued by an approved testing laboratory certifying full compliance with said AWWA standards and FCCC&HR specifications. The following testing laboratory has been qualified by Denver Water and the Colorado Department of Public Health and Environment and accepted by Denver Water to test and certify backflow prevention devices:

Foundation for Cross Connection Control and Hydraulic Research
University of Southern California
University Park
Los Angeles, California 90007

The Board Of Water Commissioners Denver Water

Engineering Standards Appendix A: Procedure For Evaluation Of Materials

A-1 General:

New products or materials related to the water industry will be evaluated by Denver Water. Sales representatives may petition for consideration and evaluation under the procedures of this Appendix.

A-2 Review Committee:

Initial application for consideration shall be made by contacting the Director of Engineering or appointed representative. If determined appropriate, the evaluation of products and materials shall be made by an ad hoc committee called by the Director of Engineering or appointed representative. The committee shall be composed of three or more Denver Water employees. The Chief of Distribution will act as chairman and the remaining committee members shall reflect Denver Water divisions affected by the proposed products.

A-3 Evaluation:

The review committee will give careful consideration to the products based upon their collective experience and opinions. They will assure themselves that proper criteria exists or will develop criteria by which the products can be evaluated. They will seek out other knowledgeable persons both within and without Denver Water and attempt to determine by this means whether the product falls clearly into one of the following categories:

1. Definitely acceptable.
2. Definitely not acceptable.
3. Borderline.

Should the product be found in Category 1 or 2, the committee will advise the Director of Engineering or appointed representative who will, in turn, advise the sales representative in writing of the findings. Should the product fall under the Category 3 (Borderline), the committee chairman will contact the sales representative for additional data, for product samples, and to arrange for testing.

A-4 Testing:

If the product has some promise but is not clearly acceptable, a testing program may be undertaken with the concurrence of the sales representative. The review committee will arrange actual field testing procedures. The sales representative shall furnish samples to be tested, any special test equipment not already available to the review committee, any

necessary appurtenant materials, pipe, gauges, charts, recording equipment, and, when necessary, a location to conduct the tests. In some instances, testing may consist of trial installations into Denver Water system. Determination of the nature of the testing shall rest with Denver Water, and Denver Water reserves the right to require full reimbursement for test and evaluation expense.

Testing shall be undertaken with the object of clearly determining the acceptability of the product. For some products where durability is in question, the test period may necessarily last for several years. Denver Water's goal will be to make an adequate determination within the minimum necessary time.

Following completion of tests, the committee will meet with the sales representative to discuss results and any further testing or consideration. The committee will then meet with the Director of Engineering or appointed representative to discuss the product and to reach a decision.

A-5 Notification:

The Director of Engineering or appointed representative will notify the sales representative in writing of his decision to either accept the product and include it into Denver Water's Engineering Standards or to reject the product as not acceptable.

A-6 Appeal:

If the product is rejected and if the sales representative has good reason to feel that his product did not receive an adequate or fair test, he may appeal in writing to the Director of Engineering. The sales representative shall fully document his allegations and ask for reconsideration based upon new facts, testing, late results, or some such factual basis. If the Director of Engineering finds reason for further consideration, he will arrange for another meeting including himself, the sales representative, the Director of Engineering or appointed representative and any other Denver Water employee who might contribute, to consider further testing or evaluation. A subsequent final decision will then be rendered in writing under the signature of the Director of Engineering or appointed representative.

If the Director of Engineering does not find sufficient cause to further investigate the matter, he shall so advise the sales representative in writing, and that decision shall be final.

A-7 Limitations on Reapplication:

If, after a product is rejected, significant changes are incorporated into its manufacture such as would render it now acceptable, the sales representative may reapply to the Director of Engineering or appointed representative for reconsideration. In the absence of changed conditions, the product will not be reconsidered for inclusion into the Engineering Standards for a period of 3 years after having been rejected.